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A three-dimensional passive-dynamic **walking robot** with two legs and knees

SH Collins, M Wisse, A Ruina - ... International Journal of **Robotics** ..., 2001 - ijr.sagepub.com

... Lateral arm motion is one possible **stabilizing** compensa- tion ... speculated that the mass properties of the four-legged design should work reasonably well in our two-legged device, and that we would use trial, error, and **correction** to minimize ... The **gait** is typical of toys of this genre ...

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[PDF] Stable control of a simulated one-legged **running robot** with hip and leg ...

M Ahmadi, M Buehler - IEEE Transactions on **Robotics** and Automation, 1997 - Citeseer

... McGeer 11] has built completely un- actuated gravity powered two-legged mechanisms capable of **walking** down inclines. ... The control problem of **stabilizing robot running** with a compliant hip for fore-aft swinging is much more dicult than that for the compliant leg (vertical ...

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Stabilization of lateral motion in passive dynamic **walking**

AD Kuo - The international journal of **robotics** research, 1999 - ijr.sagepub.com

... roll and yaw rotation and found it to be unstable but did not offer a **stabilizing** control law ... of  $I \dot{P} = 0$  and using as initial guesses the fixed points of the planar passive dynamic **walking** ma- chine ... found two solutions for each  $\alpha$  or  $\gamma$ , which were termed long- or short-period **gait** cycles ...

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A new control method for **walking robots** based on angular momentum

K Mitobe, G Capi, Y Nasu - Mechatronics, 2004 - Elsevier

... the ground reaction force and moment is important in order to control the **angular momentum** of **walking robots**. ... The selection of  $K_{ref}$  and 1 depend on the desired **gait**. ... similar with the balance mechanism of humans, where the body balance is maintained by **adjusting** the point ...

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... of a series of compact humanoid **robots** and development of biped **walk** control ...

T Furuta, T Tawara, Y Okumura, M Shimizu, K ... - **Robotics** and ..., 2001 - Elsevier

... 6. When the ESYS humanoid project commenced in 1996, biped **walking** using multiple-link virtual ... **gait** generation was proposed and shown to be successful in realizing various dynamic **walk**. ...

The last strategy has provisions for real-time **gait adjustment** due to the existence of ...

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Passive dynamic **walking**

T McGeer - The International Journal of **Robotics** Research, 1990 - ijr.sagepub.com

... Again the stance leg is left free. However, the "feedforward" **gait** is unstable, so small feedback corrections are added to maintain the **walking** cycle. ... more pure implementation, and applied them with great success to **running** machines having from one to four legs. ...

[Cited by 1277](#) - [Related articles](#) - [All 17 versions](#)

[PDF] A hop towards **running** humanoid biped

S Kajita, T Nagasaki, K Kaneko, K Yokoi, K ... - ... ON **ROBOTICS** AND ..., 2004 - Citeseer

... that these springs help **running** but they might prevent the ordinary humanoid activities including **walking**, carrying objects ... results of forward hopping and introduce an **adjustment** to obtain accurate travel distance. In Section VI, our first attempt to realize **running** is explained. ...

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### [PDF] Self-stabilizing running

RP Ringrose - 1997 - dspace.mit.edu

... Similarly, by **correcting** for the interactions between the two bipeds the resulting quadruped runs stably ... the touchdown position of the foot a function of pitch, **stabilizing** the monopod ... passive dynamic **walking** machine walks downhill using an inverted pendulum **gait**, illustrated in ...

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### Dynamic walk of a biped

H Miura, I Shimoyama - The International Journal of Robotics ..., 1984 - ijr.sagepub.com

... The most important point is that the motion of either **robot** during the single-leg support phase can be ... Thus, **stepping** must be continued to **walk** or maintain an upright, balanced posture. - Postural state is measured by potentiometers and contact sensors. ...

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### [PDF] Asymptotically stable walking for biped robots: Analysis via systems with ...

JW Grizzle, G Abba, F Plestan - IEEE Transactions on Automatic Control, 2001 - Citeseer

... passive is used in the sense that the system is not actuated, but can **walk** down an ... to use in the analysis, namely, the constraints corresponding to an impact with the **walking** surface. ... This will be achieved with the use of finite-time **stabilizing** feedback controllers [23], [4]–[6]. The ...

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**[PDF] ... : Humanoid motion planning based on the linear and angular momentum**

S Kajita, F Kanehiro, K Kaneko, K Fujiwara, ... - Proceedings of the ..., 2003 - staff.aist.go.jp  
... of a perfect multi-purpose machine [1, 2, 3, 4, 5]. However, once we **step** out the ... In Section 5, using a humanoid robot HRP-2, kicking and **walking** motions are generated ... proposed a balancing and **walk**- ing controller based on the CoM manipulation [8]. Both methods mainly ...

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**A three-dimensional passive-dynamic walking robot with two legs and knees**

SH Collins, M Wisse, A Ruina - The International Journal of ..., 2001 - ijr.sagepub.com  
... The **gait** had a visually appealing **swing** but was not robust; it only walked the full length of ... Extension 5). At this stage, side-to-side rocking increased from **step** to **step**, leading to ... We observed that human **arms** move in and forward simultaneously while **walking** naturally, so we ...

Cited by 301 - Related articles - BL Direct

**[PDF] Angular momentum regulation during human walking: biomechanics and ...**

M Popovic, A Hofmann, H Herr - ... of the IEEE International Conference on ..., 2004 - Citeseer  
... that a large class of human movements, including standing, **walking** and **running**, support conservation ... due to this assumption are limited to a small part of the **gait** cycle, and ... simplification, based on observations of human test subjects during normal **walking**, approximates the ...

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**[PDF] ... 3D Linear Inverted Pendulum Mode: A simple modeling for a biped walking ...**

S Kajita, F Kanehiro, K Kaneko, K Yokoi, H ... - Proceedings of the ..., 2001 - staff.aist.go.jp  
... Figure 5: XY -position and velocity in a **walk** of the figure 4. The tick line shows x ... The position graphs jump the distance of the **step** length at each support foot exchange, since we are ...  $CT = \cosh(T_s = T_c)$   $ST = \sinh(T_s = T_c)$  To control the **walking** speed, we must change the ...

Cited by 101 - Related articles - View as HTML - All 6 versions

**Animating human athletics**

JK Hodgins, WL Wooten, DC Brogan, JF ... - Proceedings of the 22nd ..., 1995 - portal.acm.org  
... These machines walked, jumped, changed **gait**, climbed stairs, and performed gymnastic maneuvers ([14–16 ... 8]. McMahon provides graphs of stance duration, flight duration, and **step** length as ... dynamic model and control algorithms to generate the motions of a **walking** human[ ...

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**Contribution of the support limb in control of angular momentum after tripping**

M Pijnappels, MF Bobbert, JH van Dieën - Journal of biomechanics, 2004 - Elsevier  
... 1). In about 10 out of 60 **walking** trials, one of the obstacles suddenly appeared to trip the ... Online kinematic data of each trial were used to calculate the subject's **step** length and velocity. ... **Gait** kinematics were recorded during each trial using 4 Optotrak cameras (Northern Digital ...

Cited by 21 - Related articles - All 11 versions

**[PDF] Do springboard divers violate angular momentum conservation**

C Frohlich - American Journal of Physics, 1979 - physics.princeton.edu  
... the body will have rotated a total of  $82^\circ$  between the first and the sixth **step**, even though his ... diver has **angular momentum** only about his left-right axis (dotted line) and has no twisting **motion**. At the instant pictured in (b) he sharply "throws" his left **arm** down and his right **arm** up ...

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### Synthesis of complex dynamic character **motion** from simple animations

CK Liu, Z Popović - ACM Transactions on Graphics (TOG), 2002 - portal.acm.org

... This paper strives to make a **step** in that direction. ... Less energetic motions such as **walking** or reaching are not addressed in this paper. ... fine-tuned and synchronized to each other, a wide range of realistic anima- tions can be produced, ranging from human **running**, diving [Hod ...

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### Role of **arm motion** in the standing long jump

BM Ashby, JH Heegaard - Journal of biomechanics, 2002 - Elsevier

... four cameras, a force platform, passive reflective markers, and a computer **running** a software ... into the motor control principles of activities involving both upper and lower body **motion**. **Angular momentum** analyses would be helpful in quantifying the effects **arm swing** has upon ...

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### Effects of extremity loading upon energy expenditure and **running** mechanics

AD CLAREMONT, SJ HALL - Medicine & Science in Sports & ..., 1988 - journals.lww.com

... for a kilogram of weight added to the feet or hands during **walking** and **running** ... considering that the major axis of rotation for the lower extremity during **running** is at ... Since upper extremity **movement** during **locomotion** serves largely to generate **angular momentum** counter- acting ...

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[\[PDF\] ... : Humanoid \*\*motion\*\* planning based on the linear and \*\*angular momentum\*\*](#)

S Kajita, F Kanehiro, K Kaneko, K Fujiwara, ... - Proceedings of the ..., 2003 - staff.aist.go.jp  
... 1 1 , j j m l - - O **Extremity Body** ... kick kick Figure 5: Reference velocity of right foot  $\xi_{ref} F1$  **upper**  
graph of Figure 6 shows the corresponding lin- ear **momentum** during this action. ... To achieve  
this, the robot throws back its **body** when it swings the leg back, and the 1648 Page 6. ...

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[A three-dimensional passive-dynamic \*\*walking\*\* robot with two legs and knees](#)

SH Collins, M Wisse, A Ruina - The International Journal of ..., 2001 - ijr.sagepub.com  
... It is missing **upper body** parts and degrees of freedom. ... from gravity, with no ankle extension or  
torques to accelerate leg swinging, which affects the device's **motion**. Even within our limited  
design parameters, the best-functioning **arm** motions are backward compared to anthropo ...

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[A new control method for \*\*walking\*\* robots based on \*\*angular momentum\*\*](#)

K Mitobe, G Capi, Y Nasu - Mechatronics, 2004 - Elsevier  
... The **upper body motion** is generated such that the ZMP follows the prescribed trajectory [1 and  
2]. When a ... In order to achieve stable **motion**, an accurate tracking control is needed ... **Angular**  
**momentum** is a useful physical quantity for generating the **gait** of bipedal **walking** robots [5 ...

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[Synthesis of complex dynamic character \*\*motion\*\* from simple animations](#)

CK Liu, Z Popović - ACM Transactions on Graphics (TOG), 2002 - portal.acm.org  
... center of mass (COM) of the lower **body**, COM of the **upper body**, and COM of ... in the event that  
the animator's keyframe poses force the character into unrealistic **movement**. ... they provide  
scaffolding for the **motion**, whereas dynamic constraints ensure realistic **motion** during each ...

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[Dynamic stability in elders: \*\*momentum\*\* control in locomotor ADL](#)

BK Kaya, DE Krebs, PO Riley - JOURNALS ..., 1998 - biomedgerontology.oxfordjournals. ...  
... In addition, the chair height may not have been sufficiently low to challenge lower **extremity**  
strength. ... tum control than exhibited in the sagittal and vertical planes (Table 4). The **upper body**  
of BVH ... leg and rotation of the **body** laterally to overcome the inertia of the **body** mass as ...

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[An analysis of parkinsonian \*\*gait\*\*](#)

E Knutsson - Brain, 1972 - Oxford Univ Press  
... The mean angle between **upper arm** and lower **arm** at peak extension was  $177^\circ + 12^\circ$  and at ...  
limb support, symmetry of steps and sagittal rotations in the joints of the **upper** and lower ... When  
the **body** is raised over the other limb after its weight acceptance, forward progression is ...

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[Animating human athletics](#)

JK Hodgins, WL Wooten, DC Brogan, JF ... - Proceedings of the 22nd ..., 1995 - portal.acm.org  
... swinging of the legs. However, the details of the **motion** of the **upper body** are not  
constrained by the dynamics of the task and amateur athletes use many different styles  
of **arm motion** when they run. Observations of human runners ...

[Cited by 503](#) - [Related articles](#) - [BL Direct](#) - [All 24 versions](#)

### Goal-directed, dynamic animation of human **walking**

A Bruderlin, TW Calvert - ... of the 16th annual conference on ..., 1989 - [portal.acm.org](#)

... movements not involving coordination between several limbs (eg raising an **arm** or dropping an **arm** under the ... phase of a locomotion sequence is reached, ie the forward velocity of the **body** as a ... 4.2 Stance Phase During stance the **upper body** is balanced by the torque F0. ...

[Cited by 328](#) - [Related articles](#) - [All 9 versions](#)

### Patterns of spinal **motion** during **walking**

J Crosbie, R Vachalathiti, R Smith - *Gait & Posture*, 1997 - Elsevier

... was defined in terms of the relative **motion** between the relevant thigh rigid **body** and the ... 6). The **upper** and lower trunk segments were in a neutral orientation with respect to ... be explained in terms of an overall conservation of **angular momentum**, with **arm swing** affecting these ...

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### Stabilization of lateral **motion** in passive dynamic **walking**

AD Kuo - *The International journal of robotics research*, 1999 - [ijr.sagepub.com](#)

... The pelvis is fixed to the **upper** end of the stance leg, point P, and is modeled as ... These equations were derived using a custom software package for rigid **body** dynamics (Kuo 1997 ... A full **swing** comprises the **motion** of the machine starting from the initial double-support position ...

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